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# ISSUES AND PRIORITIES IN PUBLIC FUNDING OF AGRICULTURAL RESEARCH AND EXTENSION EDUCATION



James Nielson*

In this paper I (1) briefly review the rationale for public investments in agricultural research and extension (R&E), (2) outline the events leading to the current situation confronted by public R&E, and (3) comment on the impact of these factors on the R&E agenda and the management of public investments in agricultural R&E.

We acknowledge the important contributions the private sector makes to agriculture through its research and development (R&D) efforts, dissemination of information, providing a dependable supply of inputs, and in other ways. However, this symposium focuses on public R&E.

## Why Public Investments in Agricultural Research and Extension? Who Benefits?

Public expenditures for research and education are investments that produce future benefits. Research produces new knowledge. Extension transmits knowledge from agricultural research, along with concepts and knowledge from other sources, to decisionmakers to improve the quality of their decisions and actions. Extension also provides a feedback mechanism to researchers on emerging problems.

The rationale of public investments (Federal, State, and county) in agricultural research and extension education is based primarily on:

1. The importance to the Nation and the world of maintaining an adequate food supply, and to a lesser extent, a supply of fiber.

2. Acceptance of the responsibility for working on problems that may require investments over long periods of time, that require a broad base of fundamental science, or that produce knowledge that is valuable but may not be embodied in a marketable product or service, such as on natural resources or policy alternatives. The private sector necessarily concentrates on research that has reasonably good prospects for payoff, usually in a relatively short time period, in terms of a product or service that can be marketed.

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3. The fact that most farms, many other agricultural firms, consumers, and others who benefit from it are too small to support their own R&E activities.

4. The fact that benefits often accrue not only to producers, but are broadly diffused among consumers and the public in general.

When a research investment is made, its effect on productivity or other benefits cannot be realized immediately but rather is distributed over a sequence of years required to conduct the research and to disseminate the results from it. Some agricultural research pays off in a few years; researches have shown that seven to eight years is a typical payoff period; it takes 11 to 12 years to breed a new variety of wheat; it has taken 25 years or more of research to solve some complex problems.

Figure 1 illustrates the flow of investments into a typical agricultural research project. Investments generally increase over the early years of the research activity, then as the research nears solution to a problem, investments are decreased and phased out. Resources may then be switched to other priority problems. Benefits often start to flow before the work is completed as early adopters pick up the new knowledge and put it to work. Benefits may continue long after the research is completed, but may drop off. For example, some discoveries "run out" in time as the new variety or technique is replaced by a superior one.

Many people benefit from agricultural research and extension. If the research leads to new production technology, it first benefits agricultural producers (as shown in Figure 2), generally in terms of lower costs per unit of production. As expanded output lowers prices, producer benefits fall rapidly while consumer gains go up. Consumer gains level off after a time, but persist long after producer benefits have ebbed. This has been typical of much agricultural R&E. Not only are food prices lower than they would be without the efficiencies in production that result from agricultural R&E, but the R&E efforts have also contributed to dependable seasonal and year-to-year food supplies and a more interesting variety of food products.

Many agricultural R&E endeavors have dual objectives of helping both producers and some or all nonfarm people. A number of recent projects have addressed environmental quality problems of producers and the public at large (Figure 3). For example, R&E efforts are designed to solve soil and water conservation problems of producers and at the same time solve environmental problems related to dust, pollution of streams, and sedimentation.

Some agricultural R&E activities, such as projects to improve nutritional content or safety of food, are done exclusively to help consumers and they receive the benefits (Figure 4). Producers may also benefit from these efforts, be unaffected, or be disadvantaged by them.

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Who benefits from agricultural research and extension. If the research leads to more efficient production, the first benefits accrue to agricultural producers (as shown in figure 2), generally in the form of lower costs of production. As a consequence of lower prices, producer benefits will partially shift to consumer groups. Consumers may be major beneficiaries, but producers gain through increased benefits as well. This has been typical of much agricultural research. Consumers pay food prices lower than they would be without the efficiencies in production that result from agricultural research. Research efforts have also contributed to increasing the quality of the nation's food supplies and a more interesting variety of food products.

Many agricultural research endeavors have dual objectives of helping both producers and some or all consumers. A number of research projects have increased and improved the total production of products and the public at large (figure 3). For example, new practices designed to conserve soil and water resources can increase the yields of crops on the land that reduce environmental problems such as salinization, pollution of streams, and sedimentation.

Some agricultural research activities, such as projects to improve nutritional content or safety of food, require expenditures where only consumers are the recipient of the benefits (Figure 4). Producers may also benefit from these efforts, be unaffected, or be disadvantaged by them.

Sometimes agricultural R&E that was started to help producers does so, but also gives an unforeseen bonus with results that benefit many others. For example, most people know that vitamin $B_{12}$ is essential in human nutrition. This antipernicious anemia vitamin was discovered by a poultry nutrition researcher who set out to discover how feed affected chick growth. The payoff for consumers and producers is about as shown in Figure 5. Among other discoveries of this type from agricultural research are vitamin A, streptomycin, aureomycin and discumarol.

## Events Leading to the Current Situation Confronted by Public Research and Extension

Following World War II, productivity was a major goal of U.S. society. Science and technology rated high in both public esteem and in government support. In the nonagricultural sector, major gains in productivity resulted from technological discoveries.

There was also spectacular growth in productivity in the agricultural sector from the late 1940s through much of the '60s. Public agricultural R&E were generally well supported at the Federal and State levels, and private industry R&D also made significant contributions. Together they developed and helped apply the technology that was the prime mover of American agriculture, and made it the world's most productive food and fiber system. There were dramatic increases in production, and more significantly, in productive efficiency. Total factor productivity in agriculture (all outputs as related to all inputs) increased 24 percent during the '50s.

While American agricultural technology continued to produce benefits for producers and the public, as we entered the 1970s a number of disturbing factors became increasingly apparent to the public and to those involved in publicly supported research and extension work. I identify 10 factors.

1. Natural resources

Natural resource constraints were forced into awareness as early as the 1930s. Their importance has increased in recent years with the growing competition for land and water resources for agricultural production, nonagricultural uses and recreational purposes.

2. Environment

Some of the technologies of agricultural and nonagricultural production, marketing, and processing, plus some consumption activities, produced serious environmental problems in terms of air, water, and land pollution and solid waste disposal.

3. Energy

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nologies on and off the farm were prodigious users of petroleum products. The necessity of greater conservation in the use of energy and of developing new energy sources became apparent.

4. Inflation

Quadrupling of oil prices, devaluations of the dollar, worldwide crop failures in 1972, competition for resources, expenditures to meet new environmental quality, health, and safety requirements and other factors created shock waves that resulted in double digit inflation in 1973 and 1974. The rate of inflation has declined, but it does not seem likely that annual increases in overall prices will be less than 6 percent anytime in the near to intermediate future.

5. Climate and weather

Climatologists have found increasing evidence that weather conditions during the 1950s and '60s were unusually stable and favorable for crop production in the Northern Hemisphere.

A number of climatologists believe that in the early 1970s, we entered a cooler era that will last one to two decades. During this period, they believe weather conditions will be less favorable for crop production, and that we will suffer more drouths, floods, temperature extremes, and other manifestations of climatic variability than we did in the earlier period.

Because of weather, and perhaps also other factors such as insects and diseases, the yields of a number of major crops in the U.S. have been far more variable since 1970 than they were in the period 1950-69.1/

6. International events

In the 1970s, the U.S. economy has been impacted more heavily by events in other parts of the world: inflation, recessions, currency devaluations, changes in trade policies, crop failures, and raw material shortages. Prices and availability of inputs purchased from abroad and markets for products are of great concern for those in both the agricultural and nonagricultural sectors of the U.S. economy.

7. Impacts of technology

Technological progress in agriculture from the late 1940s through the '60s produced significant benefits for farmers, consumers, and others. But it was accompanied by a number of events that are now perceived as undesirable outcomes. Examples are depletion of natural resources; degradation in environmental quality resulting from some agricultural production and processing activities; problems of families,

1/I reviewed this and related price variability in "Planning for Uncertainty in an Unstable Market," Proceedings of the National Industry-State Agricultural Research Council, Washington, D.C., October 1976.

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In the 1970s the U.S. economy has been impacted more heavily than ever by other parts of the world. Inflation, recessions, currency devaluations, changes in trade policies, crop failures, and the potential shortages, prices and availability of inputs purchased from abroad and markets for products are of great import, for those in both the agricultural and nonagricultural sectors of the U.S. economy.

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1/ Evidence for greater crop yield variability including the underlying causes is discussed in "Climate and Weather", a report of the National Research Council, Agricultural Research Council, Washington, D.C., October 1976.

rural communities, and cities resulting from farm-to-city migration; and concern for young and limited resource families who have difficulty in successfully establishing themselves in 1970s agriculture because of the high resource and managerial requirements.

Starting in the 1960s and continuing through the '70s, many people became disenchanted with science and technology. Some of the reasons for this disenchantment in and out of agriculture appear to be that technology did not always produce the intended results; that the technology sometimes produced undesirable side effects; that the R&D establishment left to the marketplace too much of the job of integrating the technology into the economy and society; and that R&E workers were slow in turning their attention to problems being experienced by some people who were affected by the new technology.

8. Changes in society goals

In addition, some of the disenchantment with science and technology appears to have resulted from changes in goals. Different individuals and groups have different goals, so it is not easy to say what "society's" goals are. Even so, it appears that since the latter part of the 1960s, goals such as production, efficiency, and income have received less attention. Other goals have been given more attention: equity, how we use and conserve our natural resources and environmental quality, with a sharper focus on social ecology or man in relation to his environment. Quality of life generally is receiving increased emphasis.

Of course, it takes income to pay for some of the goals being stressed, so productivity and income cannot be ignored. Quickly it becomes apparent that we face goal conflicts and the necessity to deal with tradeoffs between productivity and other economic, social, and quality of life goals. It is of concern to all of us how we organize to resolve these tradeoffs through political or other institutional processes at various levels.

9. Increased competition for public funds

Despite the apparent need for more public investments in agricultural R&E to meet the challenges just enumerated, public investments in agricultural R&E have increased less rapidly in the 1970s than they did in the 1950s and '60s. They have particularly increased less rapidly than the costs of conducting research and extension work, and have declined as a percentage of total Federal R&D expenditures. Increased competition for public funds is one of the reasons. Others may have been a feeling of lack of urgency because of ample food and fiber supplies and even surpluses at times; the emergence of more pressing national goals in the eyes of public decisionmakers; and possibly lack of knowledge of the impact of R&E expenditures.

10. Increased accountability

Increased emphasis on accountability is one of the most significant developments of the 1970s. The executive and legislative budgeting systems--Federal and State--now require more detailed specific documentation of projected impacts of programs for which funds are being sought, and more reports and studies of R&E activities undertaken.

The increased accountability requirements imply less freedom for public research and education managers in planning and conducting programs. It requires a larger proportion of their resources to be allocated to studying the impact of past and proposed programs and in providing reports on them. The same accountability, of course, applies to others who use public funds.

How events have affected agriculture

All of these events have had an impact on the agricultural sector. I sum them up under two headings: productivity and uncertainty.

In regard to productivity, the upward trend in crop yields that took place in the 1950s and '60s has leveled out for many crops, and there has been a general slow down in the rate of productivity increase in agriculture. Whereas, total factor productivity in agriculture grew by 24 percent in the 1950s, the rate of increase for the 1960s was only 11 percent.

Part of the decline in rate of productivity growth is attributable to the environmental quality, safety and health standards that agricultural producers, marketers, and processors are required to meet. (Since these standards are perceived by most of us as desirable national goals, we should change our accounting system to consider improvements in them as outputs.)

It seems reasonable also to conclude that some of the decline in the rate of agricultural productivity growth is attributable to the fact that R&E funds have not kept up with costs. The report of the National Academy of Sciences Committee on Agricultural Production Efficiency calls attention to the leveling off of productivity growth for a number of agricultural products, and specifically cites the slow down in new research findings as a major factor.[2/]

Additionally, many scientists, R&E administrators, and public officials believe that the technological and other problems agriculture now faces are so complex that future productivity increases in the food and fiber system will be more difficult to achieve than in the past. This implies diminishing advances in agricultural output in response to a given constant dollar input of agricultural R&E effort.

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2/ Agricultural Production Efficiency, National Academy of Sciences, Washington, D. C., 1975.

In regard to uncertainty, after two decades of relative stability during the 1950s and 1960s, American agriculture was confronted with a great deal more uncertainty in the early 1970s. This greater uncertainty is likely to continue for some time because of (1) uncertainties regarding future availability and prices of land, water, oil, fertilizer, and other inputs; (2) environmental, health, and safety regulations, including the possibilities of sudden withdrawals or restrictions on the use of output-increasing or cost-reducing inputs; (3) unequal impacts of inflation on input prices as compared to product prices; and (4) climate and weather variability.

## Impacts of Events on Agricultural R&E

At no time in its history has the agricultural research and extension system been subjected to as much study as it has recently. Food and agricultural research has been examined in depth by 15 major studies and conferences. A major evaluation of extension was called for in Title XIV of the Food and Agriculture Act of 1977, back-to-back with a similar mandate from the Office of Management and Budget.

An assessment of these studies and reports reveals a persistent concern about the long-term capacity of the present publicly supported agricultural R&E system to sustain in future decades the necessary flow of relevant new knowledge. The system is being questioned as to its ability to meet the challenges facing it in food production, human nutrition, and other priority areas mentioned previously and expanded on in the various studies and reports.

The studies and conferences have focused public attention on agricultural R&E. Most of the studies, including the World Food and Nutrition Study, have recommended increased Federal appropriations for agricultural research for the next five years.[3/] Agricultural R&E is being asked to take on new roles and to serve new audiences.

A number of independent studies have all shown that the annual rates of return to public R&E investments is somewhere between 30 and 40 percent. This would seem to make it a good investment in relation to alternative public outlays. I look forward to J. B. Cordaro's analysis of public funding.

For my part, I will outline implications of the current situation confronting agricultural R&E on the assumption that the rate of increase in appropriations will approximate the rate of inflation. Within this context, I will comment on the agenda and on the management of R&E investments.

### The R&E agenda

One of the biggest concerns of R&E workers and high level public officials is how we deal with the problem of decline in the rate of productivity increase in agriculture. This includes questions of whether or not we will have to give up significant productivity increases in order to meet other national goals.

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3/ World Food and Nutrition Study, the Potential Contributions of Research, National Academy of Sciences, Washington, D. C., 1977.

According to the World Food and Nutrition Study, productivity in agriculture can be increased through either of two routes: larger infusions of capital into agriculture, or more biological research. An economist might say the question is how we manage our R&E investments so as to move up onto the next production function, which implies new technology rather than simply more agricultural inputs.

Studies reveal that our current agricultural advances, particularly in the yield-increasing innovations of the past two decades, rest heavily on basic research advances made 20 to 30 years earlier.

It appears that tight budget constraints and demands for accountability have led to increased emphasis on applied research, especially research with high probability of tangible results in a short period of time. Many believe that the relative under investment in basic research has resulted in depletion of the stock of fundamental knowledge needed as a base for further advances in agricultural productivity. While there is by no means unanimity, there is some consensus that basic research should be increased, with emphasis on photosynthesis, nitrogen fixation, genetic engineering, and biological stress in plants. These basic biological areas, along with research on human nutrition, are stressed in USDA's competitive grants program in FY 1978.

The ultimate objective of such research is to produce food at lower cost in terms of dollars, energy use, and environmental impact. In order for the basic research to produce the desired payoff, it must be followed by the relevant applied R&E research and extension programs. The fundamental knowledge must be translated into new varieties, new production practices, and total production systems before the benefits of the new knowledge can be realized.

While there may be a question of how much stability is desirable, my analysis of uncertainty factors outlined earlier in this paper leads me to conclude that since 1972, we have had more uncertainty in agriculture than is healthy for individuals, the agricultural industry, rural areas, or for the Nation as a whole.

The R&E agenda of the future must take account of the challenges to help reduce or deal with uncertainty, through work on such things as (1) climate/weather, (2) frost control and cold hardiness research and information programs, (3) irrigation, (4) breeding plants that will produce well under a wider range of temperatures and moisture conditions, (5) extending the marketing season for certain fresh crops, and (6) use of futures markets and other marketing and management techniques that will help in dealing with uncertainty.

In the invitation to participate in this symposium, I was asked to outline the R&E agenda as viewed by the present Administration of the Department of Agriculture. Federal budget requests of the Department will reflect its appraisal of economic and social events, changes in society's goals, and the priorities of the Administration. In addition to R&E investments to address problems of productivity and uncertainty, USDA's highest priority R&E items include the following:

1. Human nutrition--including nutrient content, bioavailability of nutrients, and relation of nutrition to health and performance of various age groups.

2. Energy--including more efficient use, conservation, and development of new sources for use in agriculture and rural areas.

3. Natural resource use and management.

4. Environmental improvement.

5. Integrated pest management.

6. Small farmers--including the problems of small or limited resource families as well as the overall structure of agriculture.

In the years ahead, the agricultural R&E system will face great demands. If increases in funds do no more than match inflation, every decision to expand a line of work will have to be accompanied by a decision to make a comparable cut in another program. Even with a more optimistic outlook for funding, the system will still face hard choices and tough decisions. It is certain that there will not be enough resources to do all of the things that R&E workers, the public, the Executive Branch, and the Congress will want done.

Extension may face even more difficult decisions than research because of the variety of competing demands being placed on it and the diversity in views regarding its role. For example, some members of Congress feel strongly that extension should not be involved in 4-H work with youth in urban areas, arguing that this duplicates work done by organizations that do not require public tax funds. Other members of Congress have stated that they will support funds for extension only if 4-H work is expanded in urban areas. In my estimation, the current demands for evaluation of extension are based not so much on questions about how well it has done in the past, but rather on questions of what extension's future role should be and what audiences it should serve.

If there are more demands on R&E than can be met, how will the agenda be determined? R&E staff and administrators will have a voice in these decisions, but not as large a voice as they have had in the past. Agricultural

interests will have an influence, but it is unlikely that any farm bloc of the future can even come close to dictating the agenda. Major decisions will be made in the political arena in which conservationists, environmentalists, consumers, public accountability groups, other special interest groups, action and regulatory agencies, and others will have a significant voice. The Executive Branch will prepare and defend its agenda. Congress and the State legislatures will have the last word.

## Management of R&E

The agricultural R&E system has probably not been as quick to respond to changing needs as it might have been, even though it has been a great deal more responsive than it is sometimes credited with. However, given that it has not been as responsive as some would have liked, tight funding in relation to demands for its service, and insistence on the part of a number of interest groups that their needs be met, we can expect more constraints on the use of public R&E funds from the Executive Branch and from Congress.

The Department is committed to the concept of continued base funding of the R&E system through formula funds such as Hatch research funds and Smith-Lever extension funds. This is necessary in order for the States to maintain a corps of competent research scientists and extension educators.

For many years, the USDA has had many cooperators in addition to the land-grant universities. However, in Title XIV, Congress directed the Department to move further in opening up its science and education system to scientists and educators outside the traditional agricultural R&E system. The USDA is taking immediate steps to provide opportunity for more participation by nonland-grant colleges and universities, research and educational foundations, private industry, and the public generally. Wider participation through the National Research and Extension Users Advisory Board and the Joint Council on Food and Agricultural Sciences created by Title XIV are examples. Support of the 1890 institutions and Tuskegee Institute is strengthened under Title XIV.

Also, the Department's competitive grants program is open to all. An advisory committee assisted in planning the overall programs, and subcommittees helped develop the specifics for each area of competition. Peer panels will be used in selecting proposals to be funded. The grants are open to scientists in Federal agencies, State agricultural experiment stations, nonagricultural units of land-grant universities, nonland-grant universities, foundations, private industry, or anyone who has the interest and research capabilities to compete.

While opening up the system, the USDA intends to continue its close relationships with the State experiment stations and extension services. Also, it may be noted that even though there has been some increase in competitive grants funds, the major proportion of Federal funds going to cooperators through the USDA are still formula funds.

The USDA competitive grants program is currently directed toward basic research. Much of the basic research in agriculture is now supported by the Federal government through the National Science Foundation; the Department of Health, Education, and Welfare; and other agencies as well as USDA. Support of basic research is a logical function of the Federal government since the results of such research are universally applicable.

A concern that I have in the management of public research investments stems from the current emphasis on basic research. That is the long time period from the initiation of the research until the payoff. A study done for OMB showed that, on the average, 14 years is required before benefits begin to flow from basic research in agriculture.[4/] Some agricultural scientists and administrators have recently expressed the belief that it will take from 20 to 50 years for the payoff from investments in research on photosynthesis, nitrogen fixation, or cell biology. We have to be concerned that those who appropriate funds for research understand the time dimensions involved and have the courage and patience to support it until it has the opportunity to pay off.

Basic research also emphasizes another problem in the management of R&E programs. The search for basic knowledge demands a high degree of specialization. This tends to separate the basic researcher from his colleagues and from other problems. Many of the problems that R&E workers need to address are large, complex ones that require diverse inputs. We have made some progress, but we need to do a better job of integrating workers into multidisciplinary, multiagency, and multistate research and extension teams.

An objective of Title XIV and of the Department is not only to broaden the participation, but also to some extent, to broaden the dispersion of Federal R&E funds. However, it is conceivable that just the opposite could happen. If grants are awarded on a truly competitive basis, they will go to those who submit the best proposals and who have the greatest capabilities for carrying them out. Basic research requires sophisticated techniques and instrumentation. Given these factors, competitive grants could tend to concentrate in the larger institutions with the best equipped laboratories. Younger scientists with considerable potential, but who have not yet established a national reputation, may also have difficulty competing. The USDA competitive grants program will be operated with a view toward minimizing these dangers.

In the face of limited resources and heavy demands, all of us in the public R&E system have the responsibility of making the most effective use possible of resources entrusted to us. Every effort should be made to increase efficiencies in the management of R&E programs. Many steps have already been made in this direction.

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4/ Summary Report for OMB on Economic Benefits of FY 1979 Budget Request of the SAES, Colleges of 1890 and Tuskegee and ASCUFRO, prepared by the Interim Research Evaluation Committee of ESCOP, NASULGC, September 21, 1977.

The best use of resources requires additional efforts in the planning and coordination of programs. This is one of the major objectives of Title XIV. It is also a major goal of USDA. The reorganization of four prior agencies5/ into the new Science and Eduation Administration of the U.S. Department of Agriculture, now in progress, is part of the implementation of this goal. One of the unique features of this new agency is the design for strong staffing to assist in planning, coordination, and evaluation of research, extension, teaching, and information programs in the agricultural sciences--defined broadly as in Title XIV. Through the Joint Council, as well as the staffing, participation of all performers in the agricultural science and education system is being encouraged. Inputs in terms of ideas on needs and assessments of programs will be sought through the Users Advisory Board and in other ways. Better planning and coordination should lead to focusing on highest priority programs, and to agreements on division of labor among Federal-State-local-private partners in the total system.

Plans are being developed to tie the program planning and evaluation processes more closely to the budgetary process within the system. Greater investments will be made in evaluation research to determine the payoffs from previous programs and to predict the outcomes of new programs under consideration. These efforts should provide information that is valuable in planning and setting priorities. It may also be useful to budget agencies and Congressional committees charged with responsibilities of recommending or appropriating R&E funds.

Some cooperators have resisted the movement toward greater accountability, especially on formula funds. However, there is increasing acceptance of the concept that those who obtain public funds provide reasonably detailed and specific statements of needs and plans in obtaining the funds, and that they follow up with detailed and specific analyses of the results of the programs.

In this vein, a significant action was taken by the Experiment Station Section of the Division of Agriculture, National Association of State Universities and Land-Grant Colleges, at its meeting in Washington, D.C., in November 1977. It approved an addition to the agricultural research budgeting process that specifies that two things be done when the Executive budget is submitted to Congress: (1) the share of increases in Hatch and regional research funds be calculated for each State and the respective State experiment station director notified of the amount, and (2) the directors, in turn, inform the USDA of the specific needs and purposes to which they will commit the increased funds. Given a significant increase in these funds, this procedure would provide Federal budget decisionmakers, including the Congress, with explicit information on how fund increases would be used.

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5/ The Agricultural Research Service, Cooperative State Research Service, Extension Service, and the National Agricultural Library.

## Concluding Comments

There is currently a great deal of turmoil within the public agricultural R&E system. It stems from a variety of reasons including (1) the squeeze that comes from greater demands for work to be done in face of constant or declining support in terms of real dollars; (2) more demands for R&E to provide substitutes for previously acceptable technology now perceived as damaging to the environment or health; (3) increasingly complex problems requiring increases in real dollar support to show progress; (4) less freedom in the management of programs associated with more earmarking and other constraints; (5) increased proportion of time being spent in justifying programs rather than in conducting them; and (6) concern over the outcome of Federal government organization both within and outside the Department of Agriculture.

Title XIV calls upon the Department of Agriculture to be the leader in agricultural sciences research, extension, and teaching, not only within the Federal government, but throughout the entire system of agricultural sciences, public and private. It is, of course, easier to be a leader (or to look like one) with significant increases in budgets to allocate and manage.

The problems confronted by the agricultural R&E system will test the ingenuity of everyone in the system, and the will of those who support it. Even though large increases in public support may be difficult to obtain, if at all, I am confident that with improved planning and coordination, we can continue to conduct R&E programs with the resources available to us that are of great benefit to the agricultural industry and to the entire public.

Finally, I am confident of and dedicated to a system that preserves a paramount role in planning and conducting programs for our most precious resource--the individual research scientist and extension educator.

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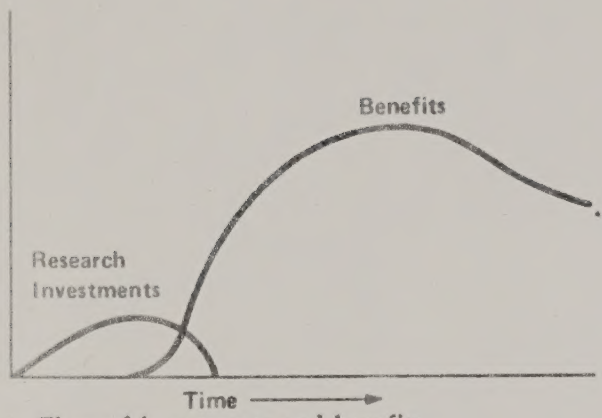
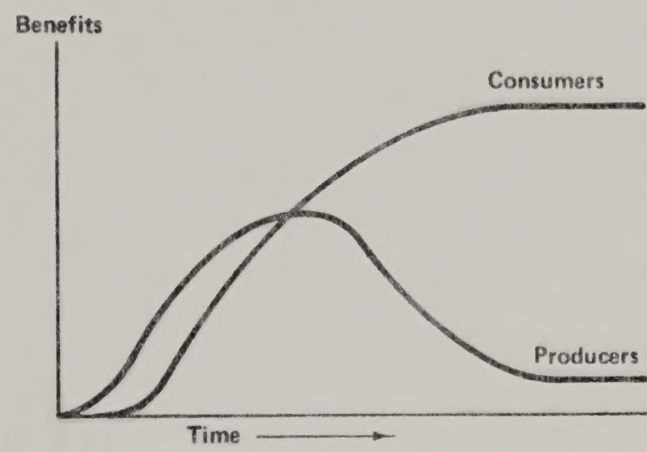
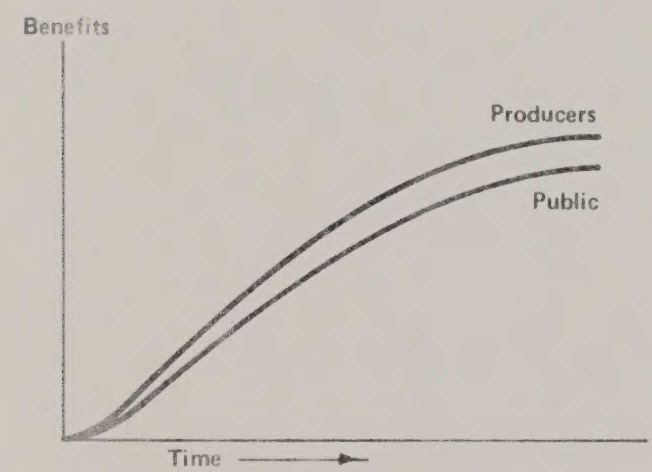


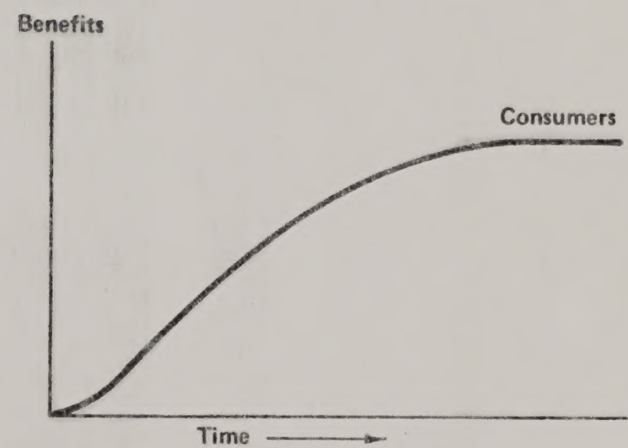

1. Flow of investments and benefits.



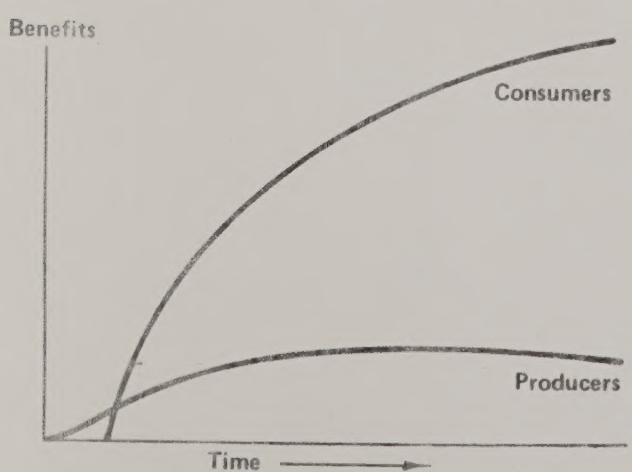

2. Benefits from new technology.




3. Environmental quality benefits.




4. Benefits from discovery in human nutrition.




5. Vitamin $B_{12}$ discovery benefits.